



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/EP99/01765 <b>(22) International Filing Date:</b> 15 March 1999 (15.03.99) <b>(30) Priority Data:</b> 09800212 18 March 1998 (18.03.98) BE <b>(71) Applicant (for all designated States except US):</b> N.V. BEKAERT S.A. [BE/BE]; Bekaertstraat 2, B-8550 Zwevegem (BE). <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> HEIRBAUT, Guido [BE/BE]; Hoogkamerstraat 288, B-9140 Temse (BE). VAN STEENLANDT, Wim [BE/BE]; Nachtegalenlaan 10, B-9100 Sint-Niklaas (BE). <b>(74) Agents:</b> MESSELY, Marc et al.; N.V. BEKAERT S.A., Bekaertstraat 2, B-8550 Zwevegem (BE).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
<b>(54) Title:</b> HETEROGENEOUS KNITTED FABRIC COMPRISING METAL FIBERS		
<b>(57) Abstract</b>  The heterogeneous knitted fabric comprises metal fibres and other fibres. The fabric has a single knitted layer structure in which yarns with a high metal fibre content are situated towards one surface and yarns with a low metal fibre content are situated towards the other surface.		

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## HETEROGENEOUS KNITTED FABRIC COMPRISING METAL FIBRES

5 The present invention relates to a relatively thin, heterogeneous knitted fabric comprising metal fibres and other fibres in which, more specifically, the yarn composition of the zone bordering its one surface differs from that bordering its other surface. Provided that the other fibres can also resist extreme temperatures, the knitted fabrics can be used for applications in very cold or in very  
10 hot environments.

Custom-made heterogeneous knitted fabrics comprising metal fibre yarns are already known from the applicant's patent WO 94/01373. The knitting pattern may hereby differ in predetermined zones over  
15 their surface, and/or through the thickness of the cloth. Patent WO 94/01372 also describes the application of this sort of heterogeneous fabric as separation cloth in the moulding of plate glass at high temperature. There is also an ever-increasing demand, in such production and in other applications, for relatively  
20 thin heterogeneous knitted fabrics comprising metal fibres that combine a relatively high air permeability with some measure of insulating capacity. The weight of such fabrics will preferably be kept to a minimum, despite the necessary proportion of contained metal fibres.

25 The heterogeneous knitted fabric comprising metal fibre according to the present invention attempts to meet this requirement by providing a plain flat knitted structure in which yarns having a high metal fibre content are present near the one surface, while yarns  
30 having a low metal fibre content are present near the other. The expression "high metal fibre content" is here to be understood to

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mean at least 30 % metal fibres by volume, preferably more than 40 % by volume, and even yarns consisting of 100 % metal fibre. "Low metal fibre content" is here to be understood to mean less than 12 % metal fibre by volume and, preferably, less than 7 % by volume. The low-content yarn may even consist 100% of other fibres. These may be carbon, glass, basalt, ceramic or synthetic fibres. The knitted fabric generally weighs less than 2 000 g/m<sup>2</sup> and, preferably, will be of a weight of less than 1 500 g/m<sup>2</sup>.

10 In order to procure the best possible fabric density (air permeability), the yarns bordering one surface, and those bordering the other surface (see overleaf) will preferably be oriented in parallel - according to the same knitting pattern - and be contiguous with each other. They behave, so to speak, as twin yarns, and can be  
15 plain flat knitted, with a flattening technique, as weft thread on a circular knitting machine or on a flat knitting machine.

The machine separation can, depending amongst other things on yarn thickness, be optionally between 5 and 30 for round knitting and between 5 and 20 for flat knitting. The yarns having a high and  
20 those having a low metal fibre content are thus simultaneously drawn in for knitting towards the same needle, each placed under sufficient tension to form a flat-knit fabric (single stitch layer) in which one of the yarns always passes in front of the other. The yarns with a low metal fibre content are usually smoother than  
25 those with a high metal fibre content.

This facilitates the flat knitting operation.

The yarns with a high metal fibre content are, preferably, staple fibre yarns in which the metal fibres, for example stainless steel  
30 fibres, have a diameter of between 4 µm and 50 µm. The yarns on the opposite side of the cloth may be filament yarns of 100% glass,

basalt or carbon or synthetic filaments with a diameter below 40  $\mu\text{m}$ . Suitable synthetic filaments include polyaramid or polyimide filaments (Kevlar (R)), brand name of du Pont de Nemours, Twaron (R), brand name of AKZO/ENKA). Spun yarns, whether or not  
5 twisted yarn consisting of one or more sorts of fibre, are equally suitable.

During the flat knitting process, one type of yarn (with high metal fibre content) can be used as well as another (with little or no metal  
10 fibres) so as to produce a fabric with zones presenting knitting patterns over its surface with differing weight per  $\text{m}^2$ , density (air permeability), stretchability or electrical conductivity. The fabric may also contain a fine interlining yarn, e.g., to reinforce the fabric as described in the applicant's Belgian patent application 97/00614.  
15 Finally, a single layer fabric zone as described above can be incorporated locally within a surrounding - e.g. double layer - knitted structure on a flat knitting machine. This then produces a knitted fabric containing the relatively thin heterogeneous knitted fabric over part of its surface. The cloth is thus heterogeneous  
20 through its thickness as well as over its surface.

### EXAMPLE

By way of example, one embodiment of the knitted fabric according  
25 to the present invention and its application as a separation cloth in the compression moulding of plate glass will now be explained in further detail. The invention is not, however, limited to this or to analogous embodiments. The cloth was fabricated at a pitch of 12 gauges on a Stoll CMS 440 flat knitting machine to a single  
30 Jersey structure without thin interlining stiffening yarn. After removal of all brightening agents from the cloth, the cloth thickness was

approximately 1 mm. The cloth counted 62.5 stitches per cm<sup>2</sup> and had a weight of 980 g/m<sup>2</sup>. This cloth displayed an air permeability (l/h/10 cm<sup>2</sup>) of 4164 and was therefore suitable as lining for the male section of the compression mould. The glass fibre surface of the cloth was in contact with the mould, the metal fibre outer surface thus forming the contact with the glass plate during moulding.

In this separation cloth, the spun (staple fibre) high metal-fibre-content yarns consisted of 100% Bekinox type AISI 316 L fibres with a diameter of 12 µm and measuring 133 tex. The low metal-fibre-content yarn consisted of a 100 % glass filament yarn measuring 136 tex.

If a heterogeneous knitted fabric according to the present invention forms a burner membrane for gas burners, coarse yarns are used. Separation on the knitting machine can be set at, e.g., 5. A 100 % metal filament yarn as described in the applicant's patent WO 97/04152 is fitted at the gas outlet side (burner face) of the membrane.

The layer fitted at the gas supply side of the cloth may be, e.g., 100 % glass yarn or ceramic yarn.

The heterogeneous knitted fabric according to the present invention can also be used as a heat shield against oven heat or as electromagnetic shielding cloth. Polishing cloth can also be fabricated according to the invention, with abrasion-resistant metal fibre yarns on the polishing side. It is further possible to imbed the heterogeneous knitted fabric in a plastic matrix. The proportion of other fibres will then preferably comprise synthetic fibres capable of combining with the plastic of the mould.

CLAIMS

1. Heterogeneous knitted fabric comprising metal fibres and other fibres, characterized in having a single knitted layer structure in which yarns with a high metal fibre content are situated towards one surface and yarns with a low metal fibre content are situated towards the other surface.
2. Circular knitted weft thread according to Claim 1, with machine separation between 5 and 30.
3. Flat knitted weft thread according to Claim 1, with machine separation between 5 and 20.
4. Knitted fabric according to Claim 1, weighing less than 1 500 g/m<sup>2</sup>.
5. Knitted fabric according to Claim 1, whereby the other fibres are glass fibres.
6. Knitted fabric according to Claim 1, whereby the other fibres are basalt fibres.
7. Knitted fabric according to Claim 1, whereby the other fibres are synthetic fibres.
8. Knitted fabric according to Claim 1 incorporating a fine multifilament liner yarn.
9. Knitted fabric according to Claim 1, which presents a heterogeneous knitted fabric over its surface.

10. Application of knitted fabric according to Claim 3 as separation cloth for the moulding of glass for vehicle windows.
- 5
11. Application of knitted fabric according to Claim 3 as burner membrane for gas burners.
12. Application of knitted fabric according to Claim 3 as heat shield.
- 10
13. Application of knitted fabric according to Claim 1 as electrically conductive cloth.
- 15
14. Application of knitted fabric according to Claim 1 as electromagnetic shielding cloth.



## INTERNATIONAL SEARCH REPORT

national Application No  
PCT/EP 99/01765

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 D04B1/14

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 D04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 44 01 417 A (AKZO N.V.) 28 July 1994 (1994-07-28) column 6, line 40 - line 59; claims 1,3,7 ---	1,4,5,7, 9
A	WO 97 04152 A (N.V. BEKAERT S.A.) 6 February 1997 (1997-02-06) page 5, line 29 - page 6, line 10 ---	1,3,4,11
A	WO 94 01373 A (N.V. BEKAERT S.A.) 20 January 1994 (1994-01-20) cited in the application ---	
A	US 3 806 959 A (GROSS) 30 April 1974 (1974-04-30) -----	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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WO 9704152	A	06-02-1997	BE	1009485 A	01-04-1997
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			EP	0839221 A	06-05-1998
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			AU	4301893 A	31-01-1994
US 3806959	A	30-04-1974	NONE		